08-02-02

2859

EXPRESS MAIL CERTIFICATE

Date 8/1/02 Label No. EV186683205-US

I hereby certify that, on the date indicated above, this paper or fee was deposited with the U.S. Postal Service & that it was addressed for delivery to the Assistant Commissioner for Patents, Washington, DC 20231 by "Express Mail Post Office to Addressee" service.

D. Davis — Name (Print)

D. Davis — Signature

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OIPE JC109 AUG 01 2002 PATENT & TRADEMARK OFFICE

Customer No.: 07278

PATENT TRADEMARK OFFICE

Docket No.: 4634/0K253US0

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Adrian Lionel GRAY

Serial No.: 10/069,037

Art Unit:

Confirmation No.:

Filed: February 15, 2002

Examiner:

For: METALLURGICAL THERMOCOUPLE

RECEIVED AUG - 6 2002 TC 2800 MAIL ROOM

CLAIM FOR PRIORITY

Hon. Commissioner of
Patents and Trademarks
Washington, DC 20231

Sir:

Applicant hereby claims priority under 35 U.S.C. Section 119 based on South African application No. 99/5203 filed August 16, 1999.

RECEIVED AUG 12 2002

A certified copy of the priority document is submitted herewith.

Respectfully submitted,

Dated: August 1, 2002

Marie L. Collazo
Reg. No. 44,085
Agent for Applicant

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Sertifikaat
PATENTKANTOOR
REPUBLIC OF SOUTH AFRICA

DEPARTEMENT VAN
HANDEL EN NYWERHEID

Certificate
PATENT OFFICE
REPUBLIEK VAN SUID-AFRIKA

DEPARTMENT OF TRADE
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Hiermee word gesertifiseer dat
This is to certify that

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The documents attached hereto, are true copies of the Application Form, Provisonal Specification and Drawings of Patent Application No. 99/5203 filed in the name of TEMPERATURE MANAGEMENT SYSTEMS (PROPRIETARY) LIMITED on the 16th August 1999 and entitled" METALLURGICAL THERMOCOUPLE".

Geteken te / Signed at PRETORIA in die Republiek van Suid-Afrika, hierdie / in the Republic of South Africa, this **10th** dag van / day of **July 2002**

Registrateur van Patente
Registrar of Patents

REPUBLIC OF SOUTH AFRICA
REVENUE
16.8.99
INKOMSTE
REPUBLIEK VAN SUID AFRIKA

FORM P1

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978
APPLICATION FOR A PATENT AND ACKNOWLEDGEMENT OF RECEIPT
(Section 30(1) - Regulation 39)

JOHN & KERNICK
PO Box 3511
HALFWAY HOUSE
1685

T440

The grant of a Patent is hereby requested by the undermentioned applicant(s) on the present application filed in duplicate

21	01	Official Application No	22	Lodging Date	47	J & K Reference
		995203		**16 August 1999**		**P 14027 ZA**

71 Full name(s) of applicant(s)

TEMPERATURE MANAGEMENT SYSTEMS (PROPRIETARY) LIMITED, a legal body organised and existing under the laws of the Republic of South Africa

REGISTRAR OF PATENTS, DESIGNS, TRADE MARKS AND COPYRIGHT
1999 -08- 16
REGISTRATEUR VAN PATENTE, MODELLE, HANDELSMERKE EN OUTEURSREG

Address(es) of applicant(s)

42 Ceramic Curve, Alton, Richards Bay, Kwa-Zulu Natal, Republic of South Africa

54 Title of Invention

METALLURGICAL THERMOCOUPLE

[ ]		The applicant claims priority as set out in the accompaning form P2. The earliest priority claimed is	
[ ]		This application is for a Patent of Addition to Patent Application No.	24 01
[ ]		This application is a fresh application in terms of S 37 and based on Application No.	21 01
		This application is accompanied by:	
X	1a	A single copy of a provisional specification of 6 pages	
[ ]	1b	Two copies of a complete specification of pages	
[ ]	2a	Informal drawings of sheets	
X	2b	Formal drawings of 1 sheets	
[ ]	3.	Publication particulars and abstract (form P8 in duplicate)	
[ ]	4.	A copy of Figure of the drawings for the abstract	
[ ]	5.	Assignment of invention (from the Inventors) or other evidence of title	
[ ]	6.	Certified priority documents (documents)	
[ ]	7.	Translation of priority documents (documents)	
[ ]	8.	Assignment of priority rights	
[ ]	9.	A copy of form P2 and the specification of S.A. Patent Application	21 01
[ ]	10.	A declaration and power of attorney on form P3	
[ ]	11.	Request for ante-dating on form P4	
[ ]	12.	Request for classification on form P9	
[ ]	13a	Request for delay of acceptance on form P4	
[ ]	13b		

74 Address for Service: JOHN & KERNICK, Midrand.

Date 16 August 1999

For the Applicant

The duplicate will be returned to the applicant for service as proof of lodging but is not valid unless endorsed with official stamp.

REGISTRAR OF PATENTS, DESIGNS, TRADE MARKS AND COPYRIGHT
Official date stamp
1999 -08- 16
REGISTRATEUR VAN PATENTE, MODELLE, HANDELSMERKE EN OUTEURSREG
Registrar of patents

FORM P.2

REPUBLIC OF SOUTH AFRICA — PATENTS ACT, 1978

REGISTER OF PATENTS

OFFICIAL APPLICATION NO.	LODGING DATE: PROVISIONAL	ACCEPTANCE DATE
21 01 99/5203	22 16th August 1999	47
INTERNATIONAL CLASSIFICATION	**LODGING DATE: COMPLETE**	**GRANTED DATE**
5	23	

FULL NAME(S) OF APPLICANT(S)/PATENTEE(S)

71 **TEMPERATURE MANAGEMENT SYSTEMS (PROPRIETARY) LIMITED**, a legal body organised and existing under the laws of the Republic of South Africa

APPLICANTS SUBSTITUTED:	DATE REGISTERED
71	

ASSIGNEE(S)	DATE REGISTERED
71	

FULL NAME(S) OF INVENTOR(S)

72 **GRAY, Adrian Lionel**

PRIORITY CLAIMED	COUNTRY	NUMBER	DATE
N.B. Use international abbreviation for country (See Schedule 4)	33	31	32

TITLE OF INVENTION

54 **METALLURGICAL THERMOCOUPLE**

ADDRESS OF APPLICANT(S)/PATENTEE(S)

42 Ceramic Curve, Alton, Richards Bay, Kwa-Zulu Natal, Republic of South Africa

ADDRESS FOR SERVICE	J & K REF:
74 JOHN & KERNICK, Waterfall Park, Midrand	P 14027 ZA

PATENT OF ADDITION NO.	DATE OF ANY CHANGE
61	
FRESH APPLICATION BASED ON	**DATE OF ANY CHANGE**

FORM P6	REPUBLIC OF SOUTH AFRICA PATENTS ACT, 1978	JOHN & KERNICK P O Box 3511 HALFWAY HOUSE 1685

PROVISIONAL SPECIFICATION

(Section 30(1) - Regulation 27)

21	01	Official Application No	22	Lodging Date	47	J & K Reference
		99/5203		16th August 1999		P 14027 ZA

71 Full name(s) of applicant(s)

TEMPERATURE MANAGEMENT SYSTEMS (PROPRIETARY) LIMITED, a legal body organised and existing under the laws of the Republic of South Africa

72 Full name(s) of Inventor(s)

GRAY, Adrian Lionel

54 Title of Invention

METALLURGICAL THERMOCOUPLE

995203

METALLURGICAL THERMOCOUPLE

FIELD OF THE INVENTION

This invention relates to thermocouples and more particularly to thermocouples for use in determining the temperature of both solid and molten metals.

BACKGROUND TO THE INVENTION

Many kinds of thermocouples have been designed and used for use in the metallurgical industry. In general in the melting and casting processes for the production of primary and secondary aluminium the use of so called "Marshall Tip Thermocouple" has become fairly standard practice. In the baking process or carbon anodes for the production of aluminium the use of wire and bead or mineral insulated thermocouples protected by special steel sheaths has become the norm.

In the ferrous metal industry platinum rhodium type thermocouples are used because the temperatures of molten steel are generally greater than those at which some of the components of the thermocouple used in the non-ferrous industry melt. It is difficult to provide insulation of the platinum rhodium element at molten steel temperatures for any length of time and insulation which will enable repeated use of the thermocouple is also difficult to provide. Consequently in the interests of economy, the thermocouple for this industry has been designed to protect the thermoelement for a maximum of about 4 minutes of immersion time, which is sufficient to obtain a single measurement.

Such thermocouples incorporate the smallest amount of the required materials, and where practical, the lowest cost materials in order to render the device expendable after only a single immersion into molten iron or steel.

Thus with an overriding cost consideration the different thermocouples have been developed to meet the particular requirements of particular applications.

There remains however the basic requirements for all thermocouples which is the integrity of the temperature measurement obtained. To achieve this it is necessary that the measuring probe be protected against electrical conductivity of its immediate protection material and further that a barrier of sufficient mechanical strength be provided against the inherently corrosive attack from the in situ environment in which the thermocouple is to be used.

OBJECT OF THE INVENTION

As stated the kind of thermocouple used in any application is driven by cost effectiveness per reading obtained. All of the thermocouples referred to suffer some or other disadvantage as a result of cost and it is the object of the present invention to provide a thermocouple which with minor modification can be used in the ferrous and non-ferrous industries and which can be made at a high cost effectiveness.

SUMMARY OF THE INVENTION

According to this invention there is provided a thermocouple comprising a length of mineral insulated thermocouple cable encased in refractory material housed in a metallic sheath.

Further features of this invention provide for the thermocouple cable to be type K or type W and for the metallic sheath to be of mild steel, any grade of stainless steel, Inconel or Nicrobel.

Still further features of this invention provide an inner metal tube around the thermocouple casing to contain the refractory material between the tube and the sheath and for a binder to be added to the refractory material to give it the required green strength. The inner tube will also usually be stainless steel.

The invention also provides for the refractory material to be acid, basic or neutral and consist essentially of alumina andalusite, magnesite, magnesia, rutile, silicon carbide, zircon, zirconia or compounds thereof and, when molten metal is the material of which the temperature is required, for the refractory to be matched to the aggregate used to line the molten metal containment vessel.

Yet further features of this invention provide for the refractory material to be consolidated between the inner tube and the sheath while maintaining its green strength and for the refractory material to be such that it will sinter in use.

The invention provides a method of shielding a thermocouple cable comprising locating beads of suitably bound refractory material between an inner tube and an outer stainless steel sheath and drawing the stainless steel sheath down to a predetermined size during which process the beaded refractory material is compacted between the tube and the sheath.

A further features of this method provides for the drawn sheath to be subsequently annealed and the refractory material to be sintered simultaneously with the annealing of the sheath.

BRIEF DESCRIPTION OF THE DRAWINGS

An example of this invention is described below with reference to the accompanying drawing which shows part of a length of thermocouple.

DETAILED DESCRIPTION WITH REFERENCE TO THE DRAWINGS

As illustrated the thermocouple (1) is made from a length of conventional thermocouple cable (2). This comprises an outer casing (3) of stainless steel around a magnesium oxide insulating body (4). An inner tube (5) is located around the outer casing (3) within an annular body of refractory material (6) contained in an outer metallic sheath (7). The inner tube and the sheath may both be made from stainless steel.

The refractory aggregate (6) may be chosen from any refractory such as alumina, andalusite, magnesite, magnesia, rutile, silicon carbide, zircon zirconia, and various compounds thereof. The aggregate may be acid, basic or neutral.

The encasing refractory is moulded within an outer sheath (5) of mild steel. Other metals such as any grade of stainless steel, Inconel or Nicrobel may be used for this sheath.

The refractory aggregate (6) must be bound to the inner tube (5) and the sheath (7) in a manner which provides sufficient strength throughout the temperature range in which the thermocouple is to operate.

Preferably the consolidation of the refractory material around the manganese oxide protected thermocouple cable is effected in the following way.

The refractory material (6) is bound into beads which are packed between the inner tube (5) or thermocouple cable casing and the outer sheath (7). The latter is then mechanically drawn down to the appropriate diameter for the final thermocouple. The beading of the refractory material provides an initial green strength to enable it to be conveniently handled.

Although the bead may be crushed and the bond destroyed during drawing, sufficient green strength arises from the great compaction which occurs, whilst the sintering properties of the refractory material remains intact.

The introduction of an inner tube provides flexibility in adapting the thermocouple produced to particular applications. The mineral insulated cable can be made longer than the sheath. This is often necessary. In addition, the one end of the sheath can be closed in the conventional manner and utilised as additional protection for conventional thermocouples made from the extended lengths resulting from the above described manufacture.

Where the thermocouple is to be used for measuring temperatures of non-ferrous metals the cable used will be type K. For use with ferrous metals the cable will be type W.

The binding of the refractory aggregate (6) moulded in a conventional metallic sheath (7) provides in use protection of the thermocouple cable from the corrosive nature of the target environment.

It should be noted however that for use in temperatures as low as 800° the strength of the refractory improves, as in situ sintering occurs.

This sintering of the consolidated refractory material further results, in high temperature applications of the thermocouple, in the sacrifice of the immersed part of the stainless steel sheath (7) to the in situ environment while nevertheless resulting in a residual monolithic shell of refractory material. This shell affords protection of the thermocouple cable from corrosive operating environment.

In this way all the handling and protective advantages afforded by the metallic sheath are retained, whilst the handling problems of the conventional ceramic sheath are avoided. Provided that the refractory aggregate is matched to the aggregate used to line the containment vessel, the best of both worlds is achieved. If for example, silicon carbide is used to line a given vessel, such as a launder or tundish, it follows that silicon carbide will be the best means of protecting the thermocouple in that vessel.

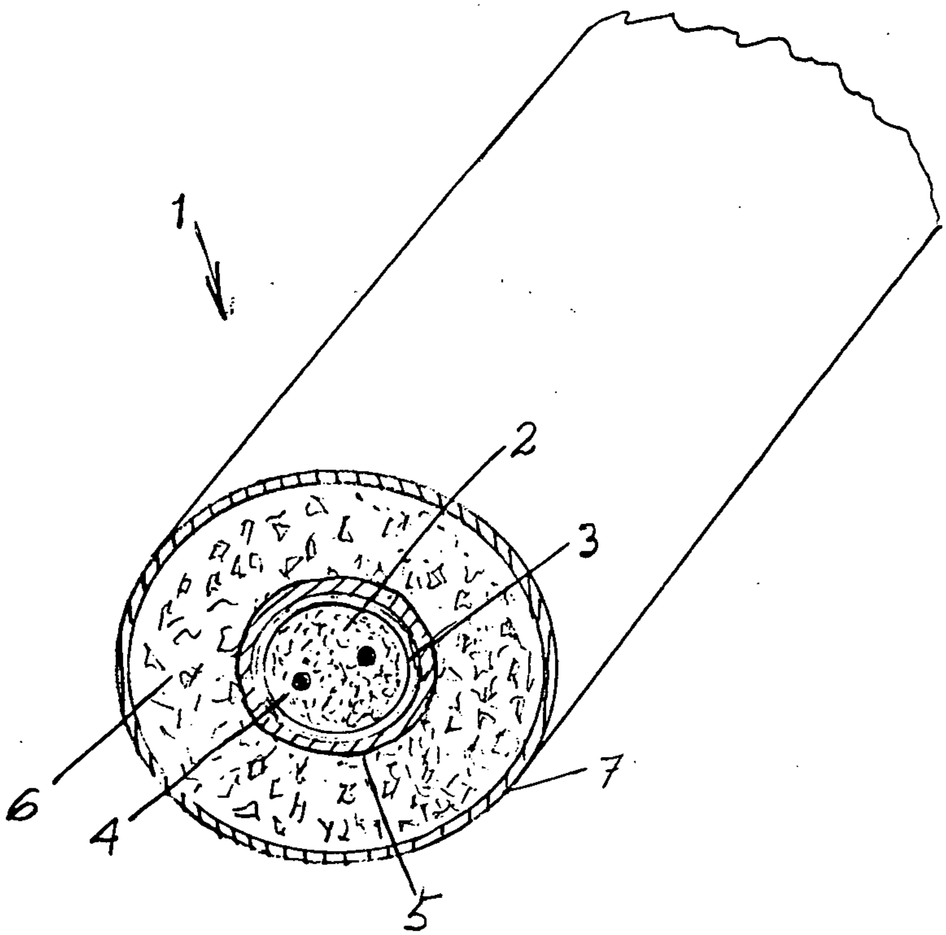
The flexibility of the thermocouple enables cost effectiveness under most conditions of use to be obtained. The final combination of outer sheath material and refractory aggregate depends entirely upon the target environment and thermocouple orientation, either vertical or horizontal.

In addition, the manganese oxide surrounds the thermoelement wire and so exposes only the surface of the ends of the two wires. In this manner, the rate of dissolution of the thermoelement into the target is reduced to an acceptable level. As a consequence, any length of the thermocouple shielded as above described becomes a thermocouple probe, and the need to form a junction between the two dissimilar metals becomes unnecessary.

This thermocouple responds instantly when immersed into molten metal, or any electrically conductive compound which bridges the two wire ends. This provides temperature measurement of liquids as well as for solids to be obtained with the same thermocouple.

DATED THIS 16TH DAY OF AUGUST 1999

JOHN & KERNICK
FOR THE APPLICANT



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